

CONCHOECIA FROM THE NORTH ATLANTIC
THE 'PROCERA' GROUP



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By MARTIN VIVIAN ANGEL

INTRODUCTION

MÜLLER (1894) decided that *Conchoecia variabilis* Müller 1890 was a confusion of two species, *C. oblonga* Claus 1890 and a new species *C. procera*. Claus (1894) also confused these two species. Later Müller (1906a) further described *C. procera*, and gave its size range as 1.05–1.35 mm for females and 0.85–1.20 mm for males. The geographical range was described as being between 31°N and 35°S in all oceans (Müller 1906a, b, 1908, 1912). It has since been further reported in the North-eastern Atlantic (Fowler 1909, Granata & Caporiacco 1949, Angel 1968, 1969a, b), the Sargasso Sea (Deevey 1968), the Benguela Current (Iles 1953), western Mediterranean (Leveau 1965), the Adriatic (Schweiger 1912, Huré 1955, 1961), the western Indian Ocean (Leveau 1967, 1968), the eastern Indian Ocean (McKenzie in press).

In 1968 R.R.S. 'Discovery' took a series of hauls in the region of 11°N 20°W, about 300 miles south of the Cape Verde Islands, to study vertical distribution patterns. It was soon apparent that adult specimens attributable to *C. procera* separated into three distinct size groupings, which showed differential depth distributions; Deevey (1968) also noted two size groupings. The middle sized group, the most abundant, is considered here to be synonymous with *C. procera sensus strictu*. The morphological differences between this group and the smaller and larger groups are sufficiently great to attribute them with specific status. They are, therefore, named *Conchoecia microprocera* sp. nov. and *Conchoecia macroprocera* sp. nov. respectively.

A single adult female taken in a deep vertical haul at 'Discovery' station 4768 in 1961 near 40°N 20°W, is also described and is ascribed to *C. vitjazi* Rudjakov 1962, another species which possibly belongs to the 'procera' group.

Conchoecia procera Müller 1894

MALE. *Carapace.* The lengths of 234 specimens from 11°N 20°W ranged from 0.98–1.04 mm with a mean of 1.020 ± 0.019 mm, and of 70 specimens from off the Moroccan coast 34°N 8°W (Angel 1968) ranged from 0.96–1.04 mm with a mean of 1.005 ± 0.009 mm. The outline of the carapace (fig. 1A, B) with the smooth curve of the posterior edge into the ventral edge broken only by the step at the opening of the right asymmetrical gland is similar to Müller's figure (1894 T. XIII fig. 39). Similarly the shape of the posterior dorsal spine (fig. 3F) is identical to Müller's figure (1894 T. XIII fig. 41) and is the character by which he separated *C. procera* from *C. decipiens* Müller in his key (Müller 1912). Edge glands are numerous down the posterior carapace margin, and are present but less abundantly along the

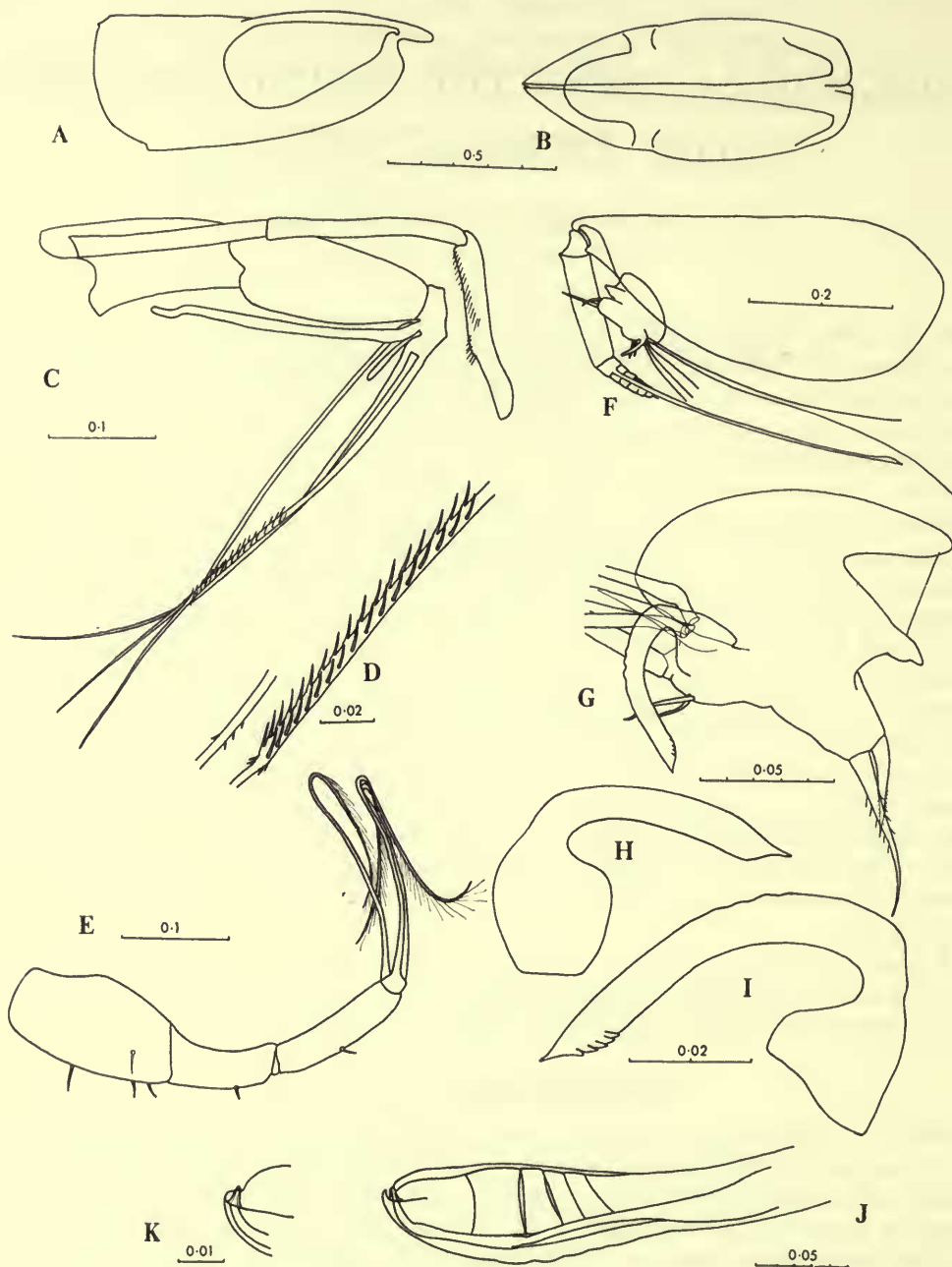


FIG. 1. *Conchoecia procera* Müller, male. A, Lateral view of carapace; B, Ventral view of carapace; C, Frontal organ and first antenna; D, Armature of the b and e setae of the first antenna; E, sixth limb; F, second antenna; G, endopodite of the right second antenna; H, left hook appendage; I, right hook appendage; J, penis; K, detail of tip of penis.

ventral margin. Live animals have not been observed to bioluminesce.

Frontal organ (fig. 1C). The shaft reaches level with the end of the limb of the first antenna. The capitulum is downturned and slightly curved. There is a small ventral swelling about half way along its length.

First antenna (fig. 1C). The first segment is shorter than the second. None of the segments carry any additional armature. The **a** seta is almost as long as the limb, reaching well beyond the joint between the first and second segments. The **c** seta is very short. The remaining three setae are almost equal with the **e** seta just the longest. The **d** seta is bare but the **b** seta has three small spines opposite the distal end of the **e** seta armature. The **e** seta has about seventeen pairs of long slender spines (fig. 1D) with two pairs of distally pointing spinules just distal of the main armature. The main spines decrease in length slightly towards the base of the seta.

Second antenna (fig. 1F). The exopodite segments carry no unusual armature. The protopodite is a little less than half the carapace length and the first exopodite segment is about $3/8$'s its length. On the endopodite (fig. 1G) the processus mammillaris is blunt with a small rounded tubercle slightly offset to one side. The **a** seta which carries fine spinules, is half the length of the **b** seta. The **b** seta is armed with much longer and stronger spines. The **c** and **d** setae are almost as long as the second segment, while the **e** seta is a minute spine. The **f** seta is only slightly shorter than the **g** seta, and both setae are thin walled terminally and unarmed. The **h**, **i** and **j** setae are short with barely developed shafts, but the **h** seta does have a small basal swelling. The left hook appendage (fig. 1H) curves through about 120° , terminally tapering into a smooth point. The right hook appendage (fig. 1G) is larger and slightly more curved. It is slightly swollen and ridged subterminally and ends in a point.

Mandible (fig. 2C). There is only a single long seta on the inner surface of the first endopodite segment, and there is no additional armature on any of the other endopodite segments. The toothed edge of the basale (fig. 2B) is typical for the genus with two tubiform teeth, six serrate teeth and an outer tooth which is unusually broad in this species. One of the outer setae is long, but the other only reaches level with the teeth. There are long hairs on the outer surface arranged in four rows, two leading up to the bases of the spine teeth. The outer teeth have very clear secondary tooth rows. The toothed edge of the coxale has ten teeth (fig. 2A). The distal tooth list consists of two large teeth, neither of which is serrate, and ten to twelve small teeth, the outermost of which is broad. The proximal list consists of 13-15 fairly regular teeth which decrease in size along the list.

Maxilla (fig. 2D). There is a basal seta. The first endopodite segment has six anterior, one lateral and three posterior setae. There is no distal armature on the first segment.

Labrum (fig. 2E). The hyaline membrane has a smooth rather shallow notch.

Caudal furca (fig. 2G). There is no unpaired seta dorsal to the eight pairs of hook spines. There is a covering of fine hairs between the caudal lamellae.

Penis (figs 1J, K). The intromittent organ has five oblique muscles. The end of the organ is rounded in outline.

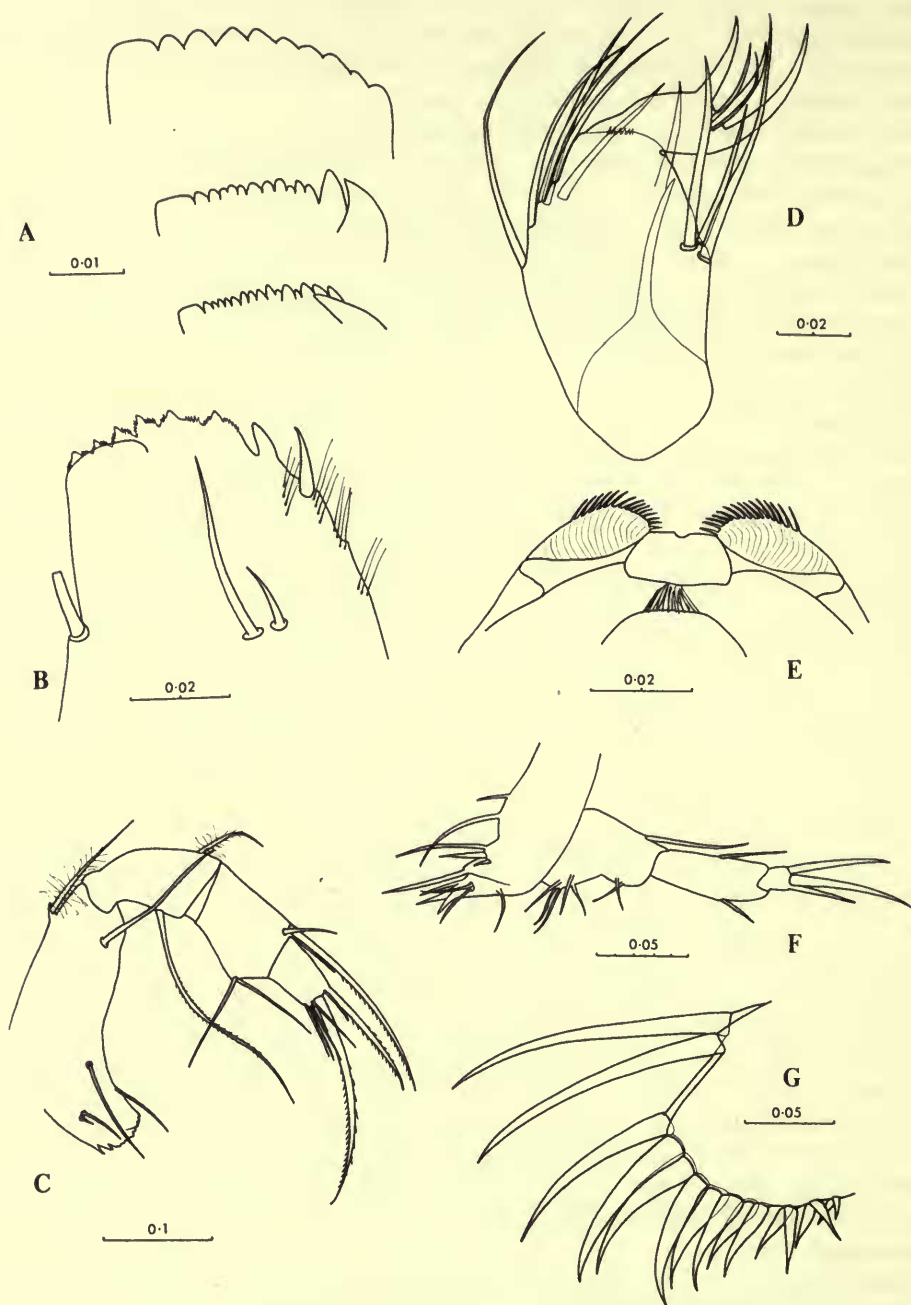


FIG. 2. *Conchoecia procera* Müller. A, mandible tooth list and toothed edge of the coxale; B, mandible toothed edge of the basale; C, mandible endopodite; D, maxilla endopodite; E, labrum; F, fifth limb; G, caudal furca.

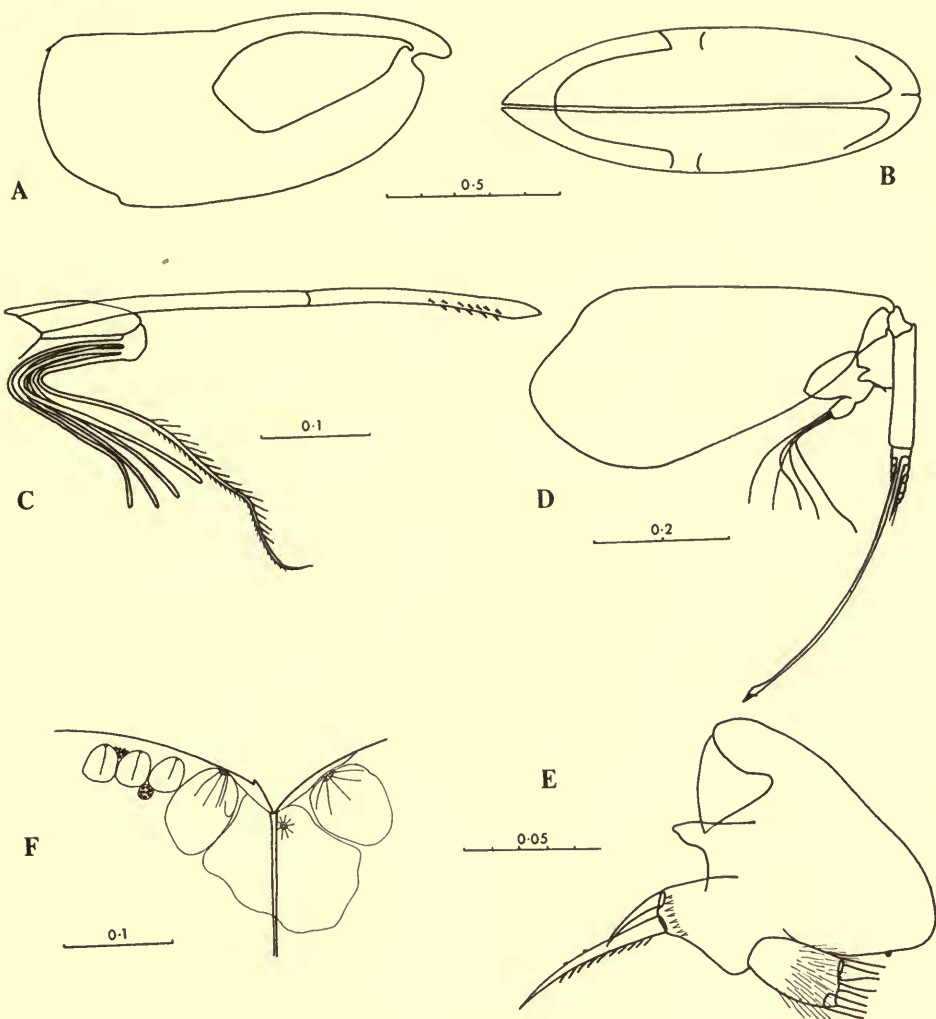


FIG. 3. *Conchoecia procera* Müller, female. A, lateral view of carapace; B, ventral view of carapace; C, frontal organ and first antenna; D, second antenna; E, second antenna endopodite; F, male detail of the posterior dorsal corner of the carapace.

FEMALE. *Carapace* (figs 3A, B). The lengths of 282 specimens from 11°N ranged from 1.12–1.24 mm with a mean of 1.181 ± 0.021 mm. 122 specimens from off the Moroccan coast ranged from 1.12–1.24 mm with a mean of 1.166 ± 0.022 mm. The change in the mean size with latitude is insignificant.

Frontal organ (fig. 3C). The capitulum is not differentiated from the stalk. The total length is about three times the length of the limb of the first antenna. It has a slight terminal swelling with a rounded knob. There are spines on its underside.

First antenna (fig. 3C). There is no additional armature. The **a-d** setae are thin walled and a little longer than the length of the limb. The **e** seta is nearly twice as long as the other setae and distal of their ends it carries long fine spinules on the anterior edge and shorter spinules on its trailing edge.

Second antenna (fig. 3D). The protopodite is $2/5$'s the length of the carapace and nearly three times the length of the first exopodite segment. The longest swimming seta is $3/4$ the length of the protopodite. On the endopodite (fig. 3E) the **a** seta is bare and less than half the length of the **b** seta. The **b** seta carries 8-9 strong spinules. On the segment near the bases of the **a** and **b** setae are about eight small spines. The second segment carries many long fine hairs (c.f. Müller 1894 T.6 fig. 61). The **c**, **d** and **e** setae are all absent. All the main setae are thin walled. The **g** seta is distinctly broader but only slightly longer than the other four subequal setae.

Synonymy. There is no clear type locality for this species. Müller (1890) described *C. variabilis* which he later (1894) decided was a confusion between *C. oblonga* Claus and *C. procera*, from the Pacific and also from the Gulf of Naples. Claus's (1894) material described as *C. oblonga* Claus included *C. procera* Müller (Müller 1906a) came from the eastern Mediterranean. It is not until Müller's (1894) original description of *C. procera* that any certainty can be attached to the identifications. However, there are no localities given for any of the material. From Leveau's (1965) rather sparse data and some specimens from the North Adriatic sent to me by Professor J. Stirn it has been possible to confirm the presence of *C. procera sensu strictu* in the Mediterranean. Müller's (1906a) material included at least one if not both of the new species described below, judging from his data on size ranges and the armature of the male antennular **e** seta. Fowler (1909) appeared only to have caught *C. procera sensu strictu* from the Bay of Biscay. Deevey (1968) reported two forms of *C. procera*, the larger of which conformed with the description above of *C. procera sensu strictu*. A re-examination of Angel's material from the Moroccan coast (1968) and from near Fuerteventura in the Canary Islands (1969a) showed that they all belonged to *C. procera sensu strictu*, with the single exception of the one adult female caught above the thermocline at 'Discovery' station 6183 haul 2. This specimen corresponded to the new species described below *C. microprocera*.

Conchoecia microprocera sp. nov.

MALE. The holotype mounted on slides in Euparal and stained with lignin pink has been deposited in the British Museum (Natural History), No. 1971.2.1.1. Locality 'Discovery' station 6665 haul 4, $10^{\circ}32.7'N$, $19^{\circ}57.4'W$. Depth 400-295 m. Time 1559-1731 hrs. Date 22 February 1968. Net Modified Indian Ocean Standard Net (N113) fitted with a catch dividing bucket (Foxton 1963, 1969).

Carapace (figs 1A, B). The range in length of 204 specimens was 0.82-0.92 mm with a mean of 0.863 ± 0.013 mm. The height and breadth of the carapace were both approximately $2/5$'s the length. In *C. procera sensu strictu* the carapace height was always measurably larger than its breadth (Table 1). There was a small

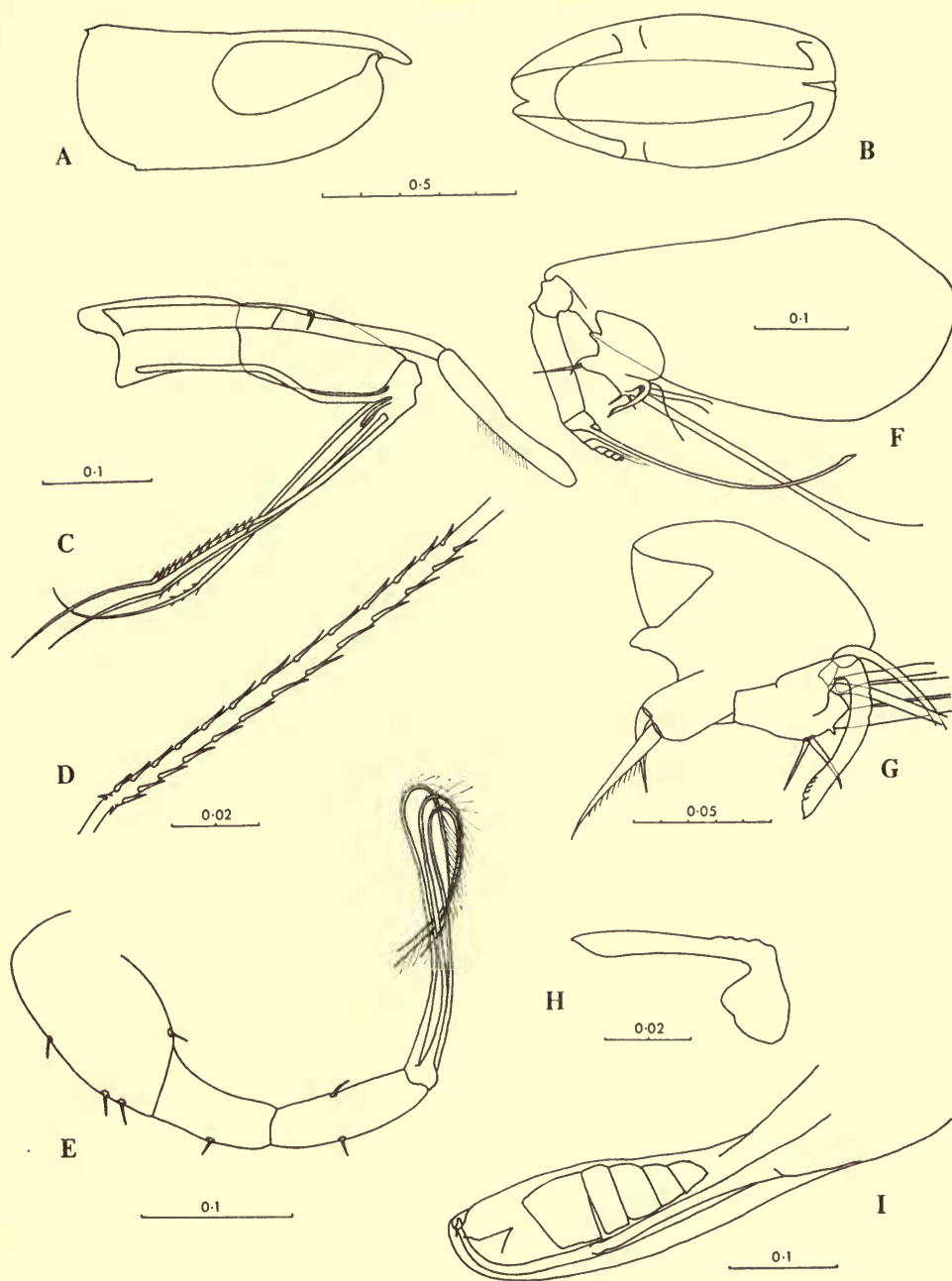


FIG. 4. *Conchoecia microprocera* sp. nov., male. A, lateral view of carapace; B, ventral view of carapace; C, frontal organ and first antenna; D, first antenna armature on e seta; E, sixth limb; F, second antenna; G, endopodite of the right second antenna; H, left hook appendage; I, penis.

spine on the right valve at the posterior dorsal corner (fig. 6F). The asymmetrical glands and the edge glands are very similar in their positions to *C. procera sensu strictu*.

Frontal organ (fig. 4C). The stalk projects just beyond the length of the first antenna. The capitulum is long and slender and curves slightly downwards. Terminally it is rounded. There is a patch of fine long hairs in the centre of the ventral surface.

First antenna (fig. 4C). There is no additional armature. The first and second segments are subequal, and there are large pigment corpuscles in the region of their articulation. The **a** seta lies back parallel with the limb and reaches almost to the base. It is relatively longer than in the other two species (Table 1). The **c** seta is extremely short. The **b** and **d** setae are subequal, only slightly shorter than the **e** seta. Both carry very fine spinules on a level with the distal end of the **e** seta armature. The **e** seta armature (fig. 4D) consists of 11-13 pairs of spines which increase very slightly in length towards the base of the seta. Beyond these main spines are two pairs of distally pointing spinules. Deevey (1968) described some of her specimens of *C. procera* as having this type of armature.

Second antenna (fig. 4F). The protopodite is more than half the length of the carapace, and this distinguishes this species from the others (Table 1). The first exopodite segment is a third the length of the protopodite and twice the lengths of the remaining exopodite segments. The longest swimming seta is about $4/5$'s the length of the protopodite. There is no additional armature on the exopodite segments. On the endopodite (fig. 4G) the processus mamillaris has a very bluntly pointed tip. The **a** seta is bare and half the length of the **b** seta. The **b** seta carries spinules for most of its length. The **c** and **d** setae are almost as long as the second segment. The **e** seta is a minute spine. The **g** and **f** setae are bare, terminally thin walled, blunt and slightly flattened. The **h**, **i** and **j** setae are short with very poorly developed shafts. The left hook appendage (fig. 4G) is right angled at its base, and then distally straight. It broadens near its end and then tapers to end in a smooth curved point. The right hook appendage (fig. 4H) is longer beyond the basal angle, and curves to terminate in a curved point with marked subterminal ridging.

Mandible (fig. 5C). The toothed edge of the basale is the usual structure for the genus (fig. 5B). The outer two setae are very short not reaching level with the teeth. There are fine hairs on the outer surface, with two rows running up to the bases of the tubiform teeth. There are no hairs on the basale between the toothed edge and the articulation with the first endopodite segment. On the first endopodite segment there are two setae on the inner edge; one very long, the other minute. The terminal claw seta is particularly long.

The toothed edge of the coxale (fig. 5A) has ten teeth. The distal tooth list consists of two large teeth, neither serrate, followed by 13-14 small regularly sized teeth. The proximal list consists of 15 irregular teeth.

Maxilla (fig. 5D). There is a basal seta. There are three posterior setae and a lateral seta on the first segment, but there are only five anterior setae compared

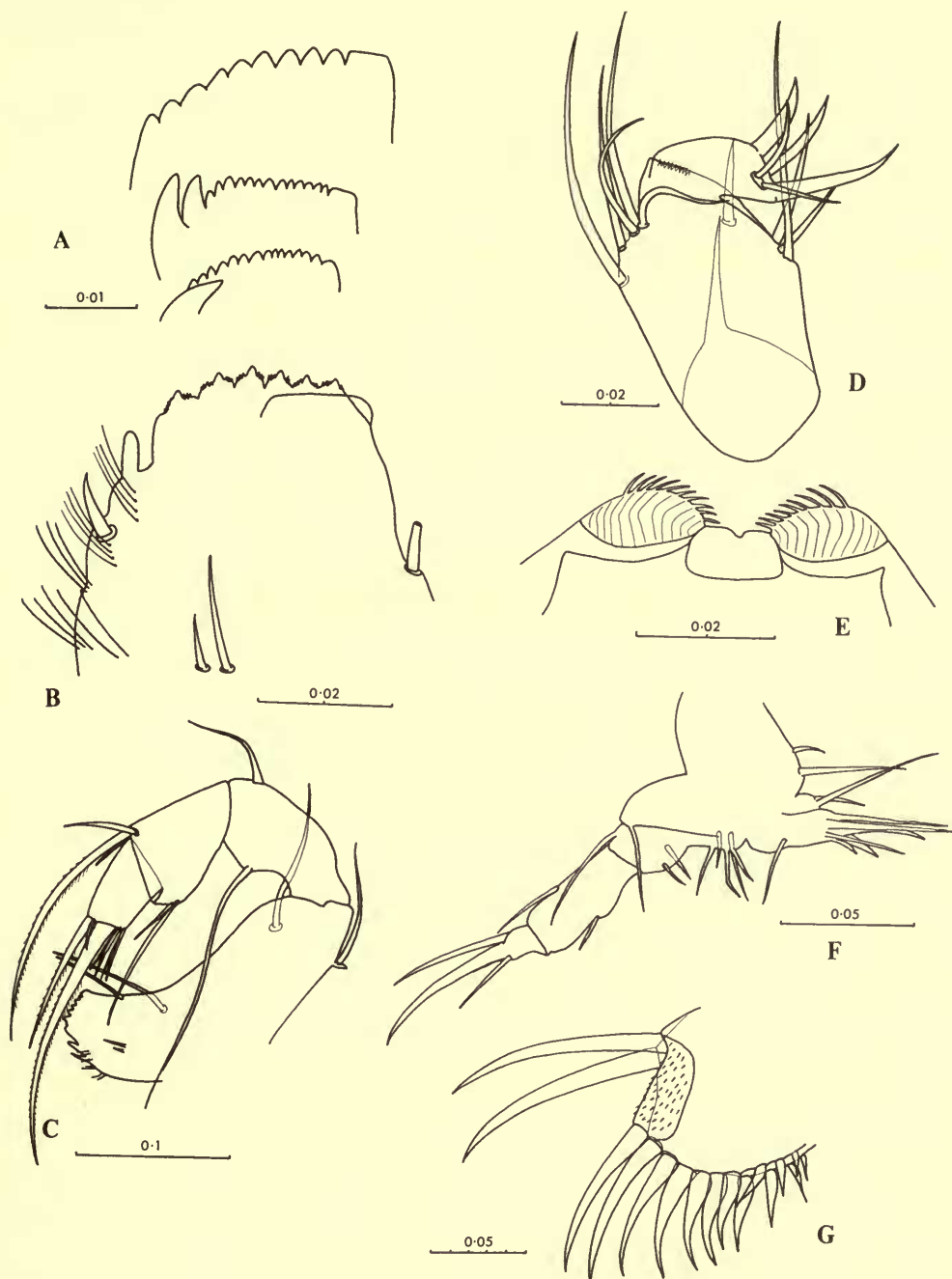


FIG. 5. *Conchoecia microprocera* sp. nov. A, mandible tooth lists and toothed edge of the coxale; B, mandible toothed list of the basale; C, mandible endopodite; D, maxilla endopodite; E, labrum; F, fifth limb; G, caudal furca.

with six in the other species of the '*procera*' group. There is a row of fine spinules on the distal edge of the first endopodite segment.

Labrum. There is a shallow smooth notch in the hyaline membrane.

Penis (fig. 4I). There are four oblique muscles. The terminal incurved end plate has two small spines.

Caudal furca (fig. 5G). There is no unpaired seta dorsal of the hook spines. There are fine hairs between the two caudal lamellae which are most clearly seen between the bases of the first and second hook spines.

FEMALE. The paratype specimen mounted on slides in Euparal and stained with lignin pink has been deposited in the British Museum (Natural History) No. 1971.2.1.2 The collection data is as for the male.

Carapace (figs 6A, B). The range in length of 260 specimens was 0.92–1.06 mm with a mean of 0.999 ± 0.023 mm. The general appearance was more hyaline than for the other closely related species. It is slimmer in appearance, but the tendency for the animals to splay open on preservation probably contributed to the insignificance in the difference between its relative breadth and those of the other species. The openings of the various glands were similar to those of the other species. The spine on the right valve at the posterior dorsal corner is well developed.

Frontal organ (fig. 6C). The frontal organ shows some evidence of differentiation into stalk and capitulum. The capitulum is a little broader and is swollen towards its tip finally ending in a down curved point.

First antenna (fig. 6C). There is no dorsal seta or other additional armature. The **a–d** setae are only half the length of the **e** seta. Distal of their ends the **e** seta carries short spinules on its posterior edge and sparse long hairs on its anterior edge.

Second antenna (fig. 6D). The protopodite is much longer relative to the carapace than in the other species (Table 1). There is no unusual armature on the exopodite. On the endopodite (fig. 6E) the processus mamillaris is rounded. The **a** seta is half the length of the **b** seta and carries very fine spinules. The **b** seta has four to six stouter spinules, and it curves into a long tapering point. On the segment near the bases of these two setae are four spines which are much longer than in the other two species. The **c**, **d** and **e** setae are absent. The main setae are all thin walled and bare. The **g** seta is only a little longer than the others but appreciably broader.

Synonomies. It is clear from Deevey's (1968) account that her material included specimens of this species; both from the size ranges and the number of spines in the armature of the **e** seta of the male antennule of her specimens described as *C. procera* Müller. No other authors give sufficient information to determine the full range of this species. Müller (1906a) also confused this species with *C. procera*. A re-examination of material from the Moroccan coast (Angel 1968) showed that the single adult female caught above the thermocline at 'Discovery' station 6183 haul 2 (34°14.5'N, 08°03.0'W) belonged to this species. Recently more specimens were taken in the vicinity of 17°45'N, 25°30'W (Angel unpublished).

TABLE I

Some meristic characters of five of the species belonging to the 'procera' group. All measurements other than carapace length are expressed as percentage of the carapace length, and are based on measurements of twenty specimens where standard deviations are given. The lengths of *C. procera* in parenthesis are for specimens from the Moroccan coast region

	<i>C. microprocera</i>		<i>C. procera</i>		<i>C. macroprocera</i>		<i>C. decipiens</i>		<i>C. vijazii</i>
	sp. nov.		Müller		sp. nov.		Müller		Rudjakov
	♂	♀	♂	♀	♂	♀	♂	♀	♀
Range	0.82-0.92	0.92-1.06	0.98-1.06	1.12-1.24	1.10-1.22	1.26-1.36	1.24	1.40	2.00
Mean length	0.863±0.013	0.999±0.023	1.022±0.019 (1.005±0.009)	1.181±0.021 (1.166±0.022)	1.153±0.021	1.304±0.021	—	—	—
No.	204	260	234 (70)	282 (122)	207	263	1	1	1
Height	41.95±1.14	42.63±1.08	42.86±0.81	43.80±0.98	40.58±1.19	40.65±1.05	46.55	45.83	(~50)
Breadth	41.61±1.09	34.52±1.18	41.53±1.24	36.57±1.05	43.80±0.86	36.65±0.90	—	35.42	—
F.O. Capit.	18.70±0.80	34.41±0.91	16.08±0.61	37.41±0.90	16.80±0.49	38.51±0.99	15.19	34.81	37.43
Shaft	40.70±0.73	—	35.44±0.75	—	35.01±0.82	—	38.79	—	—
Ant 1 Segt. 1	18.63±0.40	—	16.20±0.38	—	14.83±0.40	—	17.24	—	—
" 2	18.52±0.30	—	16.65±0.46	—	16.92±0.39	—	18.10	—	—
Total	40.15±0.73	15.65±0.85	35.39±0.80	12.65±0.40	35.18±0.66	14.09±0.34	39.66	20.00	13.90
a seta	27.67±1.25	—	22.73±0.88	—	21.86±0.97	—	20.47	—	—
b "	45.14±0.95	16.71±0.46	42.48±1.03	17.65±1.02	43.34±0.88	17.32±0.56	45.04	13.89	21.39
c "	4.62±0.23	—	5.24±0.49	—	5.23±0.31	—	7.54	—	—
d "	45.40±0.79	—	42.29±1.06	—	43.57±1.01	—	45.26	—	—
e "	46.38±1.05	32.06±0.84	44.42±1.05	31.91±0.67	46.62±1.08	32.24±0.80	46.12	30.37	42.78
Spines	(2+11-13) × 2	—	(2+16-18) × 2	—	(1+28-32) × 2	—	2 × 29	—	—
Ant 2 Protop.	51.93±0.74	45.43±0.78	46.61±1.04	41.51±0.75	46.34±0.68	41.43±0.56	50.00	41.85	39.04
Exop. 1	17.21±0.30	16.12±0.30	17.09±0.53	15.34±0.38	16.61±0.41	14.98±0.30	17.24	14.81	22.99
" 2-8	8.68±0.30	7.72±0.23	7.41±0.20	6.49±0.16	8.12±0.15	7.17±0.09	8.62	8.15	8.02
LSS	41.34±1.63	34.49±1.05	37.64±1.07	32.86±0.88	41.74±1.28	34.34±0.80	39.66	34.07	50.80
g seta	42.07±1.30	16.95±0.43	39.80±1.42	19.81±0.81	43.73±1.26	20.01±0.52	44.83	24.44	43.85
f "	36.12±1.59	—	34.88±1.64	15.83±0.50	38.54±1.23	15.82±0.53	35.34	16.30	35.29
h, i, j setae	10.09±0.56	14.97±0.93	9.53±0.44	—	9.27±0.51	—	10.78	14.07	31.01

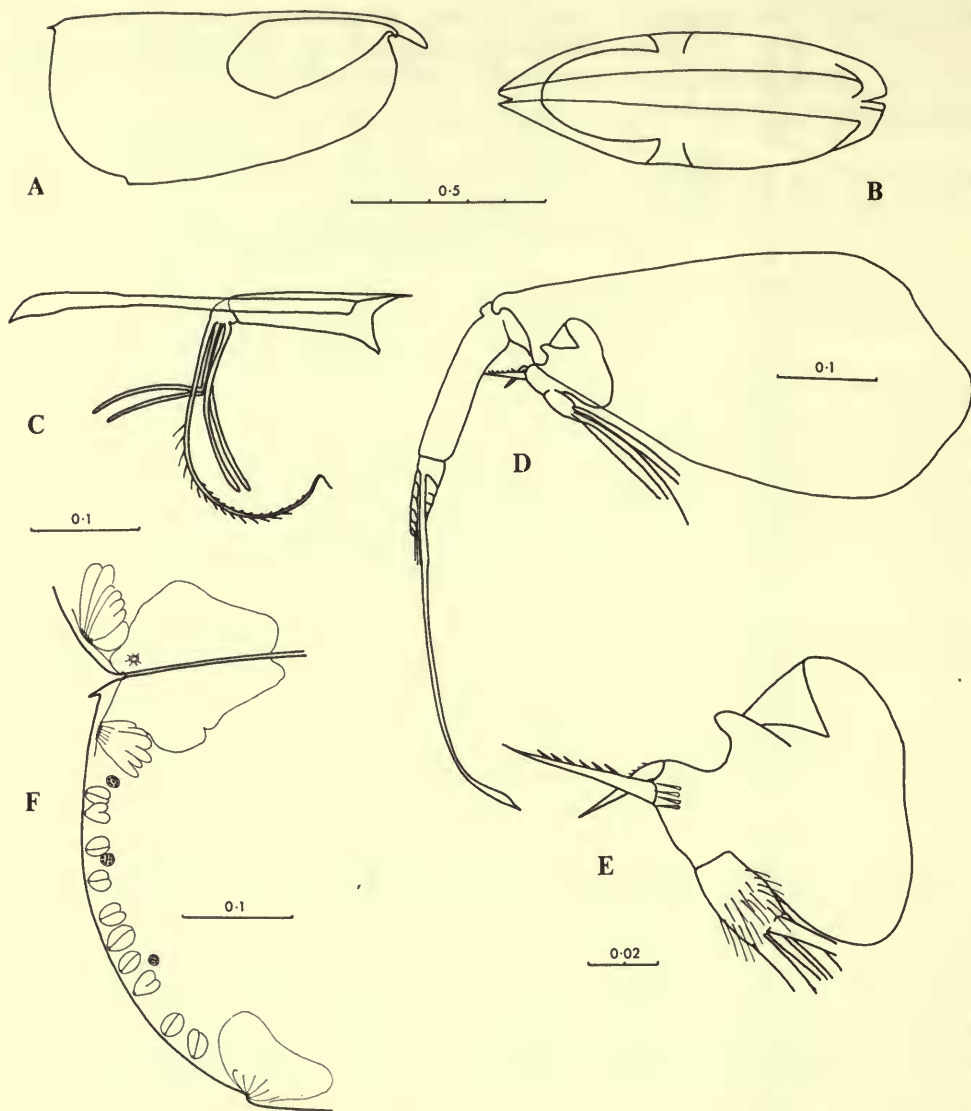


FIG. 6. *Conchoecia microprocera* sp. nov., female. A, lateral view of carapace, B, ventral view of carapace; C, frontal organ and first antenna; D, second antenna; E, second antenna endopodite; F, male detail of the posterior dorsal corner of the carapace.

***Conchoecia macroprocera* sp. nov.**

MALE. The holotype specimen mounted on slides in Euparal and stained with lignin pink has been deposited in the British Museum (Natural History) No. 1971.2.1.3. Collection data as for *C. microprocera* sp. nov. (see above).

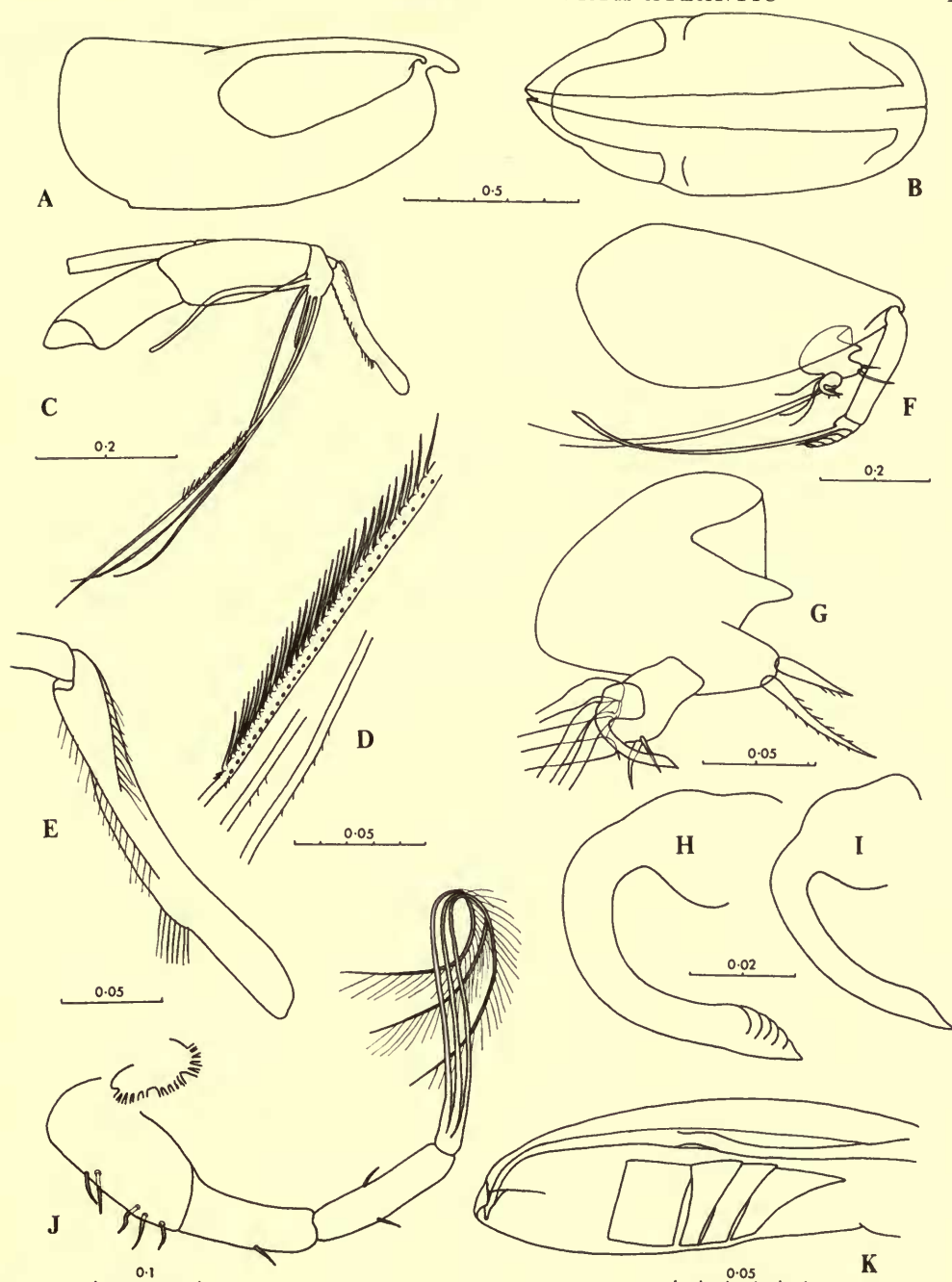


FIG. 7. *Conchoecia macroprocera* sp. nov., male. A, lateral view of carapace; B, ventral view of carapace; C, frontal organ and first antenna; D, first antenna detail of armature of the e, d and b setae; E, frontal organ capitulum; F, second antenna; G, left second antenna endopodite; H, right hook appendage; I, left hook appendage; J, sixth limb; K, penis.

Carapace (fig. 7A). The range in size of 207 specimens was 1.10–1.22 mm with a mean of 1.153 ± 0.021 mm. The relative height tended to be less and the breadth greater than for the other species. However, a distinguishing feature is that in all specimens the carapace breadth was greater than the height. The openings of the various glands are as described in the other species. There is no spine on the right valve at the posterior dorsal corner (fig. 9F) (c.f. Müller 1906a T. XIII fig. 37).

Frontal organ (fig. 7C). The shaft reaches level with the end of the limb of the first antenna. The capitulum is long and down turned. Two lateral thickening bars carry fine long hairs for the proximal third. The ventral edge has a small swelling on its median third, on the distal end of which is a more obvious group of long hairs. The dorsal edge is concave and bare. The end of the capitulum is rounded with a low subterminal knob (fig. 7E). One of Müller's figures (1906a T. XIII fig. 45) shows some resemblance to the frontal organ of this species.

First antenna (fig. 7C). The first segment is much shorter than the second; contrasting with the other two species. The ganglionic body, which lies in the region of the articulation between the two segments contains many yellow brown pigment corpuscles. The **a** seta lies back parallel with the limb reaching beyond the end of the second segment. The seta is significantly shorter than in *C. microprocera*, but not significantly so than in *C. procera* Müller. The **b** and **d** setae are sub-equal and only carry six and three minute spinules respectively on a level with the distal end of the **e** seta armature. The **e** seta armature (fig. 7D) consists of 28–30 pairs of long slightly curved spines which increase in length slightly towards the base of the seta. Distal of the main armature are two pairs of distally pointing spinules.

Second antenna (fig. 7F). The relative lengths of the protopodite and exopodite are similar to those in *C. procera* Müller. The longest swimming seta is longer and more closely approaches the protopodite length than in the other species. The **a** seta on the endopodite (fig. 7G) is $2/3$'s the length of the **b** seta and has a few very fine spinules. The **b** seta carries more longer spinules. The **c** and **d** setae are nearly as long as the second segment. The **e** seta is minute. The **g** seta is only a little longer than the **f** seta. Both the **g** and **f** setae are bare and the **g** seta is slightly flattened. The **h** seta has a slight swelling near its base. The left hook appendage (fig. 7I) has a basal right angle and then curves gently a further 30° or so. Terminally it tapers asymmetrically to a blunt point. The right hook appendage (fig. 7H) curves through a total of 150°. The end is swollen with subterminal ridging and ending in a blunt asymmetrical point.

Mandible (fig. 8C). The toothed edge of the coxale (fig. 8A) has ten low blunt teeth. The distal tooth list consists of two large teeth, the second of which is serrated, followed by about twelve small regularly sized teeth. The proximal list has twelve to fifteen teeth regularly diminishing in size across the list.

The toothed edge of the basale (fig. 8B) consists of the usual two tubiform followed by six wedge teeth with a single broad outer tooth. The outer setae are short and fail to reach the level of the teeth. There are five rows of hairs arranged on the surface between the insertion of the outer setae and the two tubiform teeth. On the inner edge of the first endopodite segment is a single long seta. The second segment is bare on its outer edge.

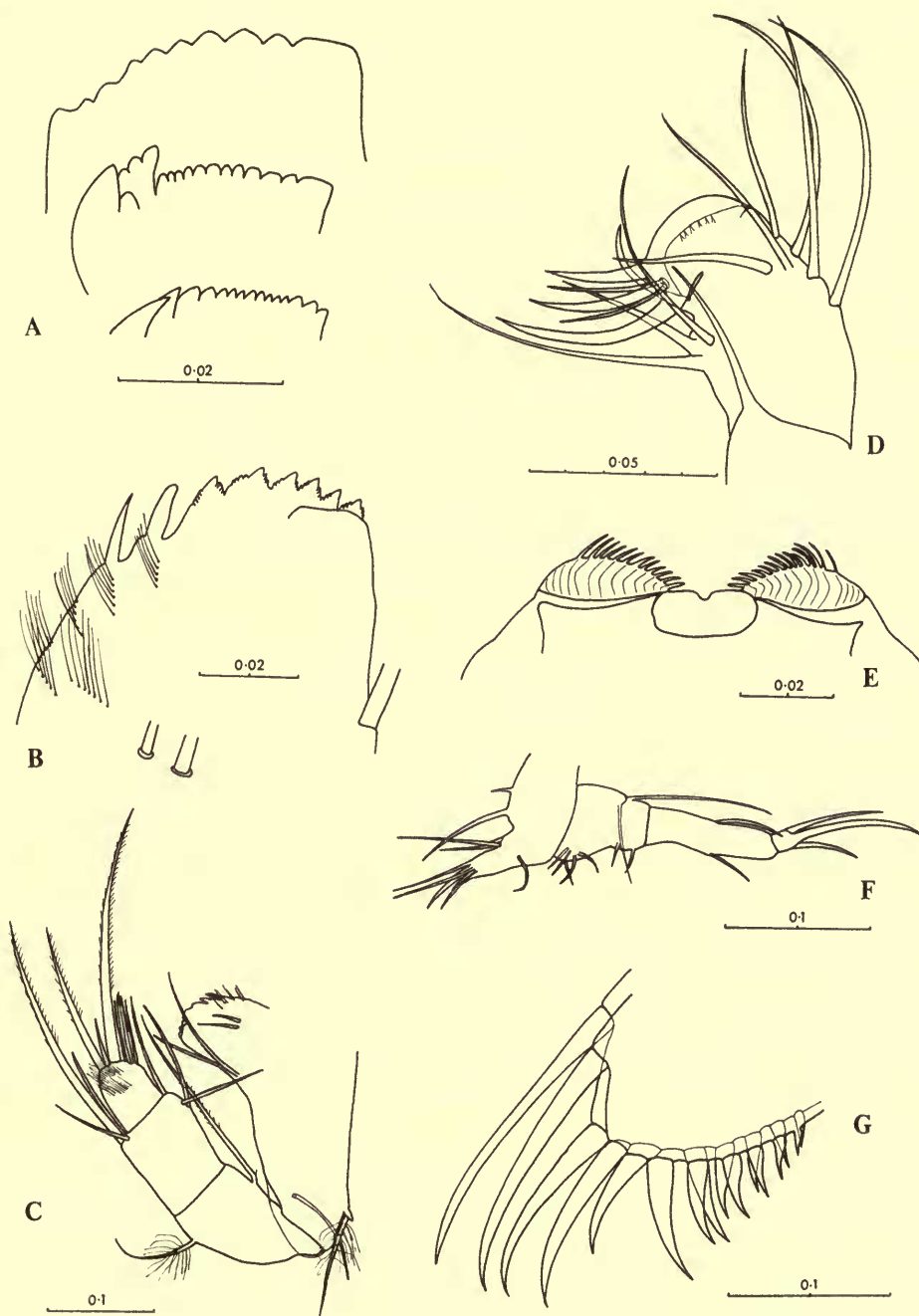


FIG. 8. *Conchoecia macroprocera* sp. nov. A, mandible tooth lists and toothed edge of the coxale; B, mandible toothed edge of the basale; C, mandible endopodite; D, maxilla endopodite; E, labrum; F, fifth limb; G, caudal furca.

Maxilla (fig. 8D). There is a basal seta. On the endopodite the first segment carries six anterior, one lateral and three posterior setae. There are about six spinules on the distal edge of the segment near its articulation with the second segment.

Labrum (fig. 8E). The hyaline membrane has a shallow rounded notch.

Caudal furca (fig. 8G). The first hook spines reach just short of the tips of the second pair. There is no unpaired seta dorsal of the hook spines. Between the two caudal lamellae is a covering of fine hairs.

Penis (fig. 7K). The end of the organ is rounded and it contains four oblique muscles.

FEMALE. The paratype mounted on slides in Euparal and stained with lignin pink has been deposited in the British Museum (Natural History) No. 1971.2.1.4. Collection data as for *C. microprocera* sp. nov.

Carapace (figs 9A, B). The range in length of 263 specimens was 1.26–1.36 mm with a mean of 1.304 ± 0.021 mm. The relative height of the carapace is noticeably less than for *C. procera* Müller although its breadth is similar. The asymmetrical glands are positioned as in the other two species. There is no spine on the right valve at the posterior dorsal corner.

Frontal organ (fig. 9C). The total length of the organ is nearly three times the length of the limb of the first antenna. There is some demarcation into shaft and capitulum. Near the rounded tip there is a row of spines on the ventral surface.

First antenna (fig. 9C). The segmentation is indistinct and there is no additional armature. The **a–d** setae are more than half the length of the **e** seta. The **e** seta carries short spinules on its posterior edge and sparser long spinules on the distal half of its anterior edge.

Second antenna (fig. 9D). The ratio of the relative lengths of the segments of the limb are very similar to those for *C. procera* Müller (Table 1), although the longest swimming seta does tend to be longer. On the endopodite the **a** seta is bare and $2/3$'s the length of the **b** seta. The **b** seta carries a few short spinules. On the segment near the bases of these setae are about eight short fine spinules. The second segment is almost bare with only about three or four hairs. All the main setae are bare and thin walled. The **g** seta is only a little longer than the others but is much broader.

Synonomies. Müller (1906a) gave a size range for *C. procera* which suggests that his material included this species. Similarly Leveau's (1965) report of *C. procera* Müller reaching a length of 1.30 mm may indicate its presence in the Mediterranean. Leveau reported two centres of abundance in *C. procera* Müller at 200–100 m and 500–300 m. It seems possible that the deeper population may be this species. The species was absent from Deevey's (1968) material, but has turned up in very small numbers recently in samples taken near 17°45'N, 25°30'W (Angel unpublished). Thus this species may not normally occur north of about 18°N in the North Atlantic.

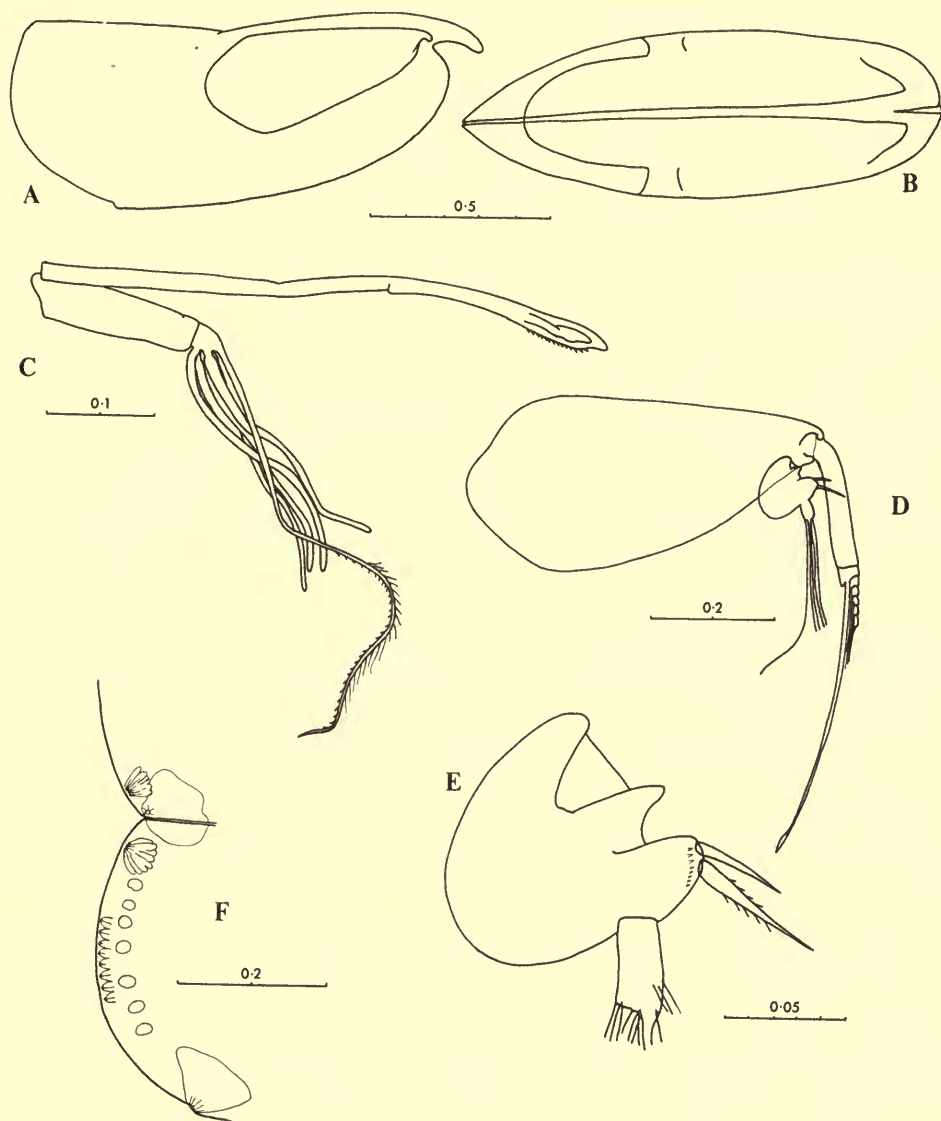


FIG. 9. *Conchoecia macroprocera* sp. nov., female. A, lateral view of carapace; B, ventral view of carapace; C, frontal organ and first antenna; D, second antenna; E, second antenna endopodite; F, details of the posterior dorsal corner of the male carapace.

Conchoecia vitjazi Rudjakov 1962

MATERIAL. A single female was found in a 'Discovery' net (Currie & Foxton 1957) haul from 'Discovery' station 4768, position 40°03'N, 19°57'W, depth 4750–4000 m, time 1402–1640 hrs, date 12 October 1961. Since no description is available in English, the specimen is described in full.

MALE. The male is unknown.

FEMALE. *Carapace*. The length of the 'Discovery' specimen is 2.00 mm. Rudjakov's specimens ranged from 2.20–2.30 mm. The 'Discovery' specimen was too distorted to make accurate measurements of carapace height and breadth, but the height is about half the carapace length. The whole carapace is covered with a fine V-shaped sculpturing (fig. 10A). The right asymmetrical gland opens on a small prominence (possibly an artefact) and the left asymmetrical gland about 0.1 mm from the posterior dorsal corner (fig. 10A). The right valve carries a minute spine at the posterior dorsal corner. The outline of the carapace is very similar to Rudjakov's (1962) figure 2a.

Frontal organ (fig. 10B). The organ is much longer than the limb of the first antenna. There is no clear distinction into stalk and capitulum. Terminally the organ is down-turned and carries a few small spinules on the ventral corner (fig. 10C).

First antenna (fig. 10B). The segmentation is indistinct and there is no additional armature. The dorsal seta is absent. The *e* seta is over twice the length of the other setae and only carries a few fine spinules on the distal third of its trailing edge. These spinules were on the third quarter of the *e* seta in Rudjakov's specimens.

Second antenna (fig. 10E). The proportion of the protopodite : exopodite segment 1; exopodite segments 2–8 is 6 : 3 : 1 in the 'Discovery' specimen and 4 : 2.8 : 1 in Rudjakov's specimens. On the endopodite (fig. 10F) the processus mamillaris is small and bluntly pointed. The *a* seta is bare and two thirds the length of the *b* seta. The *b* seta carries a group of long hairs near its base and very fine spinules for about half its length. The *c*, *d* and *e* setae are all absent. The *g* seta is as long as the protopodite, and is flattened terminally with fine spinules along the edge of the flattened part. The other setae are long subequal, thin-walled and without shafts.

Mandible (fig. 11B). The toothed edge of the basale is typical for the genus (fig. 11A). The broad outer tooth is as broad as three of the other teeth. The outer setae project just beyond the level of the teeth. There are four groups of hairs near the bases of the tubiform teeth. Between the toothed edge and the articulation with the first endopodite segment is a patch of fine hairs. The inner edge of the first endopodite segment carries one long seta reaching well beyond the tips of the shorter of the terminal setae, and three minute setae arranged in a line up the segment. On the distal half of the outer surface of the outer segment is a patch of fine spinules. The toothed edge of the coxale has nine unusually elongate teeth (fig. 10D). The distal list has two large teeth, the second of which is very serrated, followed by 17 small teeth. The proximal list has a large tooth followed by about six small teeth, another large tooth and a further 20 smaller irregular teeth. This is in substantial agreement with Rudjakov's (1962) type description. There is a seta on the distal outer edge of the first segment which Rudjakov noted as absent but was probably broken off in his specimens.

Maxilla (fig. 11C). The maxilla has a long basal segment. There are six anterior, one lateral and three posterior setae on the first segment. There are no spines

on the outer edge of the segment. The second endopodite segment is long and thin with long terminal hook setae.

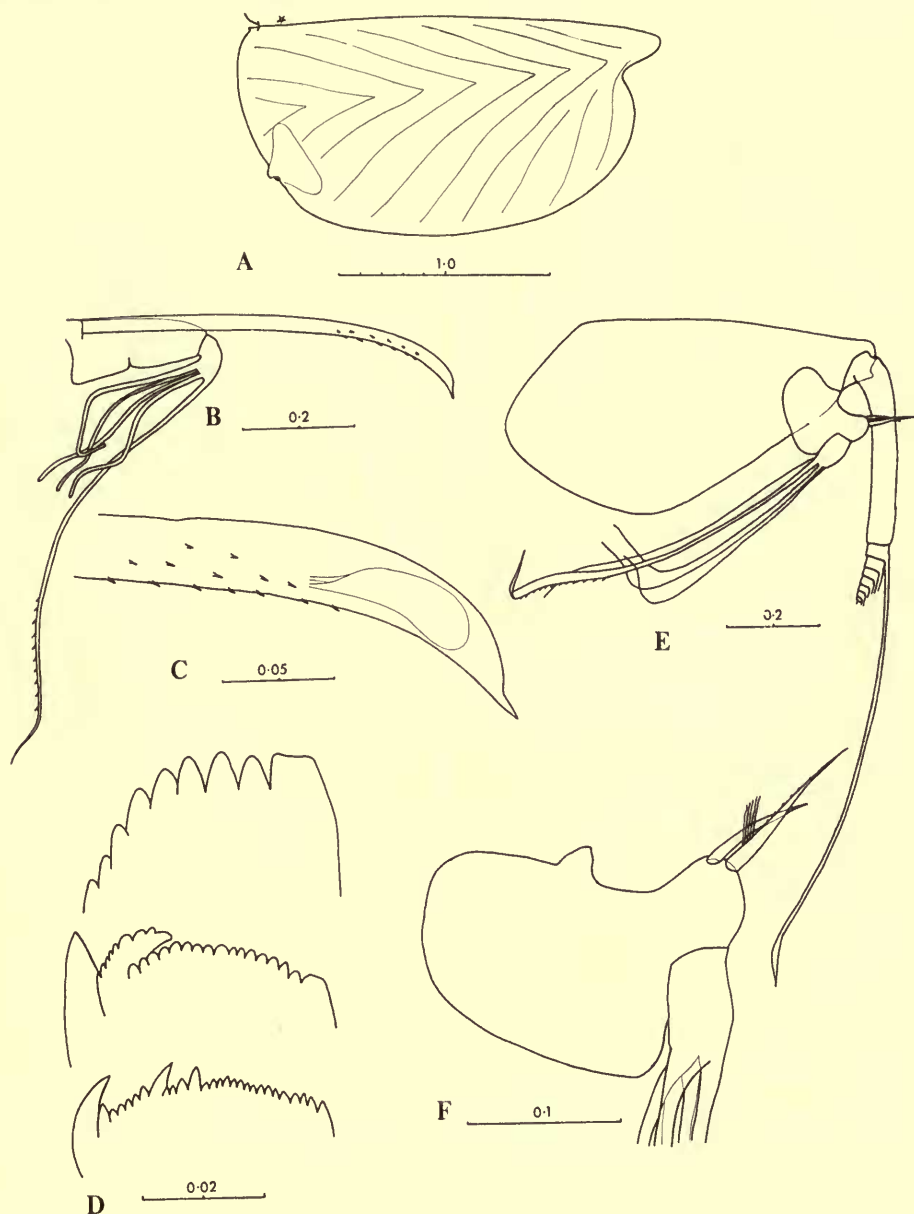


FIG. 10. *Conchoecia vitjazi* Rudjakov, female. A, carapace right valve mounted flat; B, frontal organ and first antenna; C, detail of the tip of the frontal organ; D, mandible tooth lists and toothed edge of the coxale; E, second antenna; F, second antenna endopodite.

Labrum. The hyaline membrane has a deep rounded notch.

Caudal furca. The first pair of hook spines just fail to reach level with the ends of the second pair. There is an unpaired seta dorsal of the hook spines. Between the lamellae is a covering of fine hairs.



FIG. 11. *Conchoecia vitjazi* Rudjakov, female. A, mandible toothed edge of the basale; B, mandible endopodite; C, maxilla endopodite.

DISCUSSION

At 'Discovery' station 6665 *C. procera* Müller was most abundant by day from 50–300 m, *C. microprocera* sp. nov. was most abundant at 25 m and occurred in quite large numbers down to 100 m, *C. macroprocera* sp. nov. was most abundant

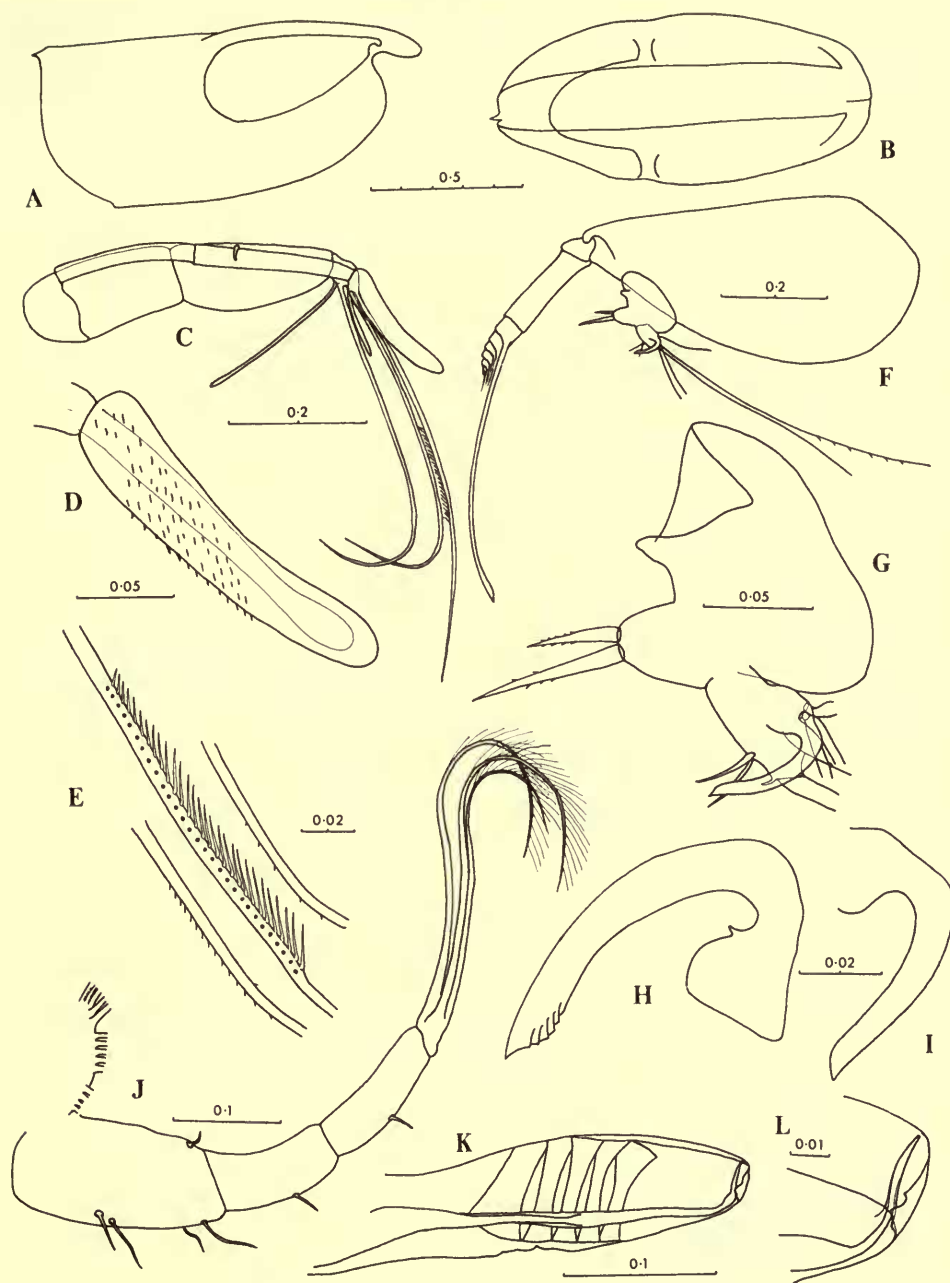


FIG. 12. *Conchoecia decipiens* Müller, male. A, lateral view of the carapace; B, ventral view of the carapace; C, frontal organ and first antenna; D, frontal organ capitulum; E, first antenna armature of the b, e and d setae; F, second antenna; G, left second antenna endopodite; H, right hook appendage; I, left hook appendage; J, sixth limb; K, penis; L, details of the tip of the penis.

from 500–300 m and was absent from above 200 m. At night *C. procera* and *C. microprocera* showed reverse migrations out of the surface 50–75m, whereas *C. macroprocera* did not migrate.

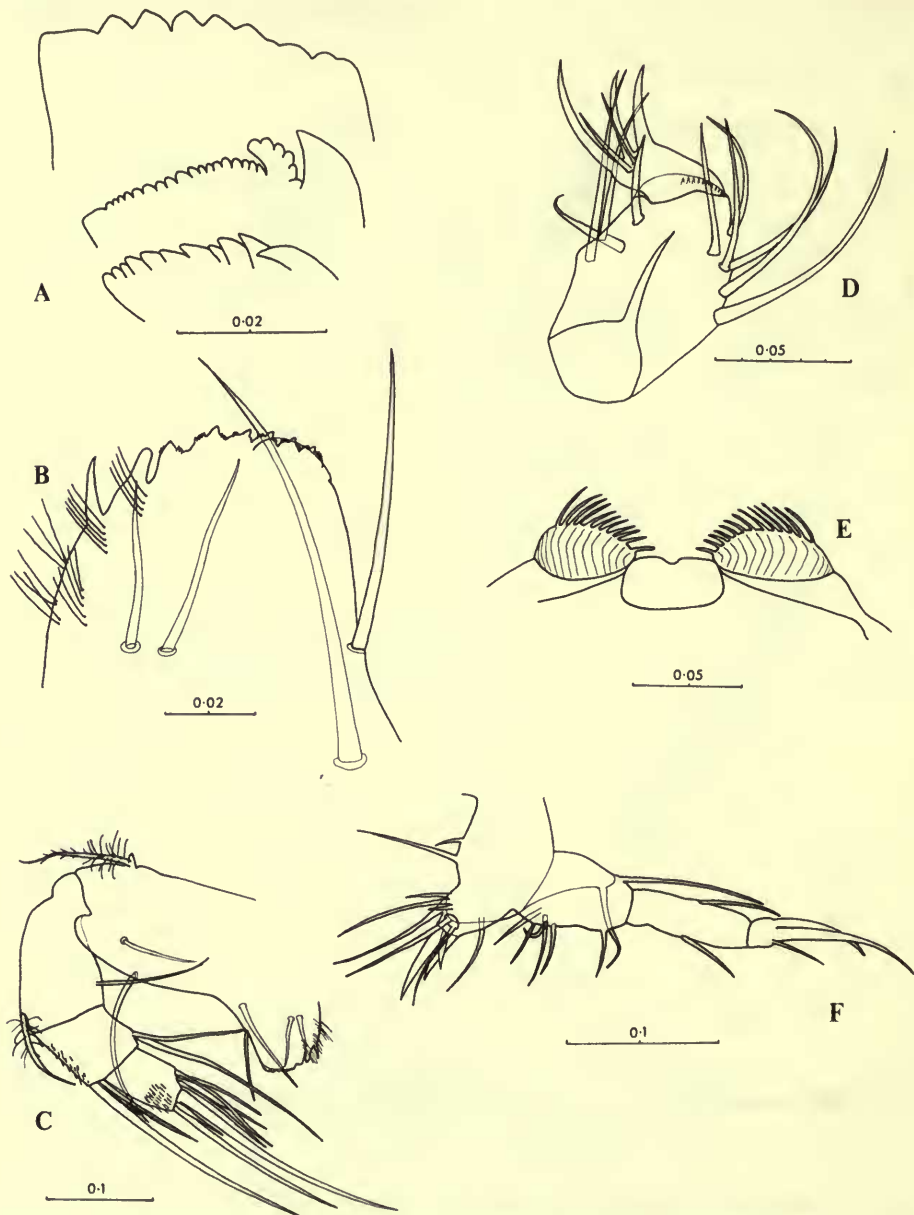


FIG. 13. *Conchoecia decipiens* Müller. A, mandible tooth list and toothed edge of the coxale; B, mandible toothed edge of the basale; C, mandible endopodite; D, maxilla endopodite; E, labrum; F, fifth limb.

The other species which have been attributed to the '*procera*' group are *C. decipiens* Müller 1906a, *C. brachyaskos* Müller 1906a and *C. vitjazi* Rudjakov 1962. *C. decipiens* has only been reported from the Indian Ocean from between 23°N (Leveau 1968) and 25°S (Müller 1908). To show clearly the differences between *C. decipiens* Müller and the other species, especially *C. macroprocera* sp. nov. drawings of specimens lent me by Mr J. George of the Cochin Indian Ocean Sorting Centre are included (figs 12, 13, 14). Table 1 also includes measurements of the specimens.

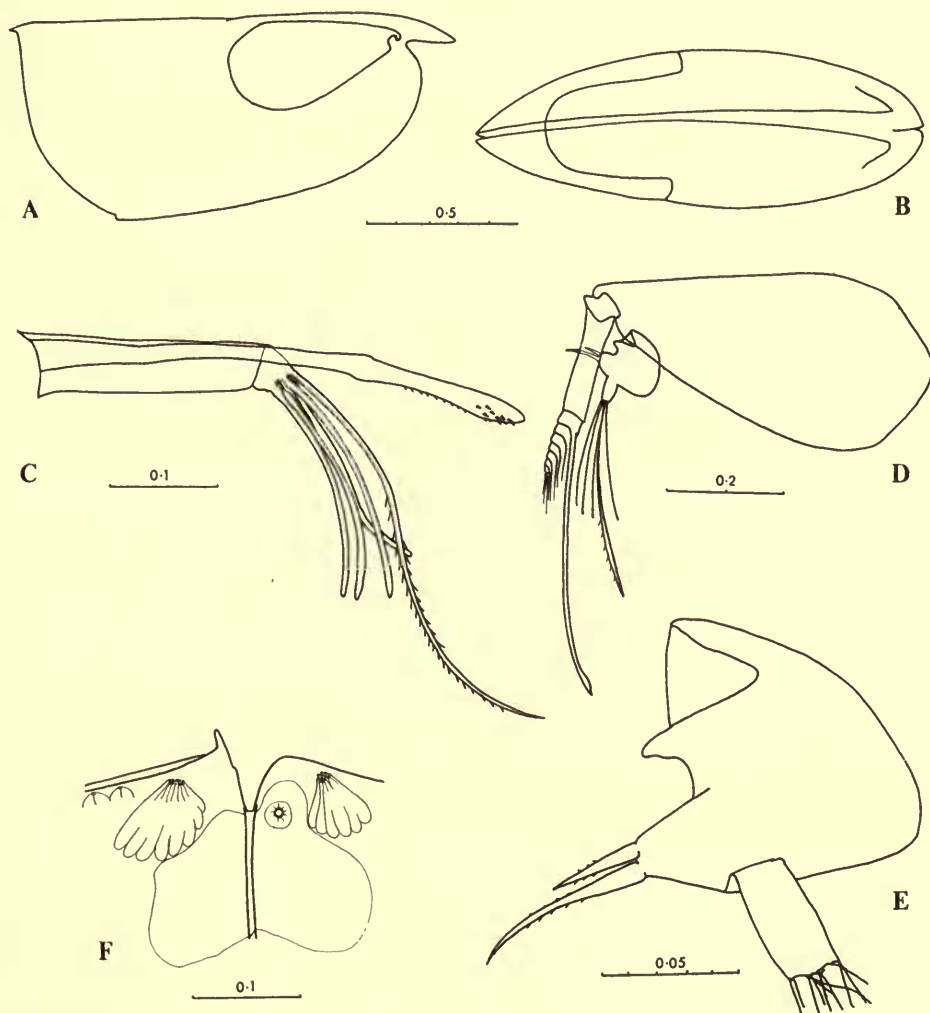


FIG. 14. *Conchoecia decipiens* Müller, female. A, lateral view of the carapace; B, ventral view of the carapace; C, frontal organ and first antenna; D, second antenna; E, second antenna endopodite; F, male, detail of the posterior dorsal corner of the carapace.

C. decipiens Müller has a large spine and secondary spine on the right carapace valve at the posterior dorsal corner. In the males the following characters distinguish *C. decipiens* from *C. macroprocera*: (1) The capitulum of the frontal organ is distinctive. (2) The first antenna is relatively longer in *C. decipiens*. (3) The first antenna *e* seta armature has no distally pointing spinules and the main spines decrease in size proximally. (4) On the second antenna the protopodite is longer and the shape of the right hook appendage is distinctive. (5) The endopodite of the mandible carries two setae on the inner face of the first segment. (6) The penis has five oblique muscles.

In the females the following characters distinguish *C. decipiens* from *C. macroprocera*: (1) The outline of the carapace, (2) the shape of the frontal organ, (3) the endopodite of the second antenna has no spinules on the first segment near the bases of the *a* and *b* setae, the second segment is completely bare and the *g* seta is markedly flattened.

Müller (1906a) included *C. brachyaskos* in the '*procera*' group on the basis of the female frontal organ and the shortness of the sensory setae on the endopodite of the male second antenna. However, because of the setation of the male first antenna and its distinctive *e* seta armature (Müller 1906a T. XIV fig. 12), it has not been included here. *C. brachyaskos* Müller was present in the deep midwater samples from 'Discovery' station 6665. There are two size groups; the larger occurring only from below 1000 m. This large form is superficially very similar to the Antarctic form and so this species requires careful taxonomic investigation before its status can be certain.

The discovery of a specimen attributable to *C. vitjazi* Rudjakov in the North Atlantic provides an interesting example of the faunistic relationships between the Pacific and the North Atlantic (c.f. Briggs 1970). This species, only recorded before from below 6000 m in the Kurile-Kamchatka Trench (46°31'N, 154°22'E, 43°48'N, 149°55'E), was considered by Rudjakov (1962) to be endemic to that region. The 'Discovery' specimen does show some minor variations from the type description, but these are not considered great enough to attribute to it new specific rank. The male of the species is yet to be described and so the inclusion of the species in the '*procera*' group is yet to be confirmed.

SUMMARY

1. *Conchoecia procera* Müller is shown to have been confused with two very closely related but distinct species in the past.

2. *C. procera sensu strictu* is described and the two new species are described and named *C. microprocera* sp. nov. and *C. macrorprocera* sp. nov.

3. An adult female ascribed to *C. vitjazi* Rudjakov 1962 is described from the North Atlantic; a species previously thought to be endemic to the Kurile-Kamchatka Trench.

4. The inclusion of *C. brachyaskos* Müller in the '*procera*' group is questioned.

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